Power tool with planet type reduction gearing.

The invention relates to a power tool in which a rotation motor is connected to an output shaft via a planet type reduction gearing.

A common problem concerned with power tools of the above type is to minimize the dimensions of the gearing as well as the outer dimension of the tool for a certain level of torque output. In power nut runners, for instance, the motor speed is reduced in at least two stages such that in the last stage the rotation speed is quite low while the transferred torque is high. In this type of tool, it is also desirable to have a low gear ratio in the last stage, which means that the planet wheels in that stage have to have a small diameter. This means in turn that there is very little space left for the needle bearing supporting each planet wheel on the planet wheel carrier. Accordingly, the material thickness between the bases of the gear teeth and the outer race of the needle bearing will be too small, and the fatigue strain at the bases of the gear teeth will be too high to meet the demands of an acceptably long service life of the gearing.

One solution to that problem could be to make the planet wheels longer so as to distribute the torque related forces on the gear teeth over a longer distance. This will not work in practice, however, because an even gear teeth engagement and force distribution over a long gear wheel is impossible to obtain, because of torsional deflection of primarily the sun gear and the planet wheel carrier. The result would be that the tension level in the teeth will still be too high at the torque input side of the gears.

Another way to solve this problem could be to split the planet wheel bearing into two bearings located on opposite sides of the planet wheel. By this arrangement the

torsional deflection of primarily the planet wheel carrier would misalign the gear teeth relative to the sun gear and the ring gear, which would result in high local gear teeth stresses on the gear teeth.

It is the main object of the invention to provide a power tool with a planet type reduction gearing having an improved planet wheel arrangement allowing small size planet wheels to be used despite a heavy torque load being transferred.

Further objects and advantages of the invention will appear from the following specification and claims.

A preferred embodiment of the invention is described below with reference to the accompanying drawing.

In the drawings
Fig. 1 shows a side view of a power tool according to the invention.
Fig. 2 shows a longitudinal section through the reduction gearing of the power tool shown in Fig. 1.
Fig. 3 shows a perspective view of the second stage planetary gearing of the reduction gearing in Fig. 2.

The power tool illustrated in Fig. 1 is a hand held power nut runner which comprises a housing 10 with a rear handle 10a and an angle head 10b. The tool further comprises a rotation motor (not illustrated), and output shaft 11 for carrying a nut socket, and a reduction gearing 12 connecting the motor to the output shaft 11. The purpose of the reduction gearing 12 is as usual to reduce the rotation speed of the motor and amplify the torque delivered by the output shaft 11.

In Fig. 2, the reduction gearing 12 is shown in detail and comprises two planetary gearings 13,14 arranged in two

consecutive stages. The gearing 13 of the first reduction stage comprises a sun gear 16 formed integrally with a drive spindle 17 connectable to the motor. At its rear end, the drive spindle 17 is provided with a coupling socket 18 which supports a coupling sleeve 19 and an intermediate sleeve 20. The intermediate sleeve 20 is formed with inner splines 21 to be engaged by matching splines on the motor shaft.

An elongate tubular ring gear 22 is secured to a support member 23 for mounting in the housing 10. The first stage planetary gearing 13 comprises a set of planet wheels 24 journalled on a planet wheel carrier 25 via stub axles 26 and needle bearings 27. The planet wheels 24 engage both the sun gear 16 and the ring gear 22 and transfer torque to the planet wheel carrier 25. The planet wheel carrier 25 is secured to a shaft 30 which is formed with gear teeth to form the sun gear of the second planetary gearing 14.

The second planetary gearing 14 comprises a planet wheel carrier 32 with a socket portion 33 coupling the gearing to the output shaft 11. On the planet wheel carrier 32 there are supported three planet wheel units 35 each comprising two separate and axially spaced spur gears 36,37 which both engage the ring gear 22 as well as the shaft 30. These spur gears 36,37 are mounted on a common spindle 38 which is journalled relative to the planet wheel carrier 32 via a needle bearing 39. One of the spur gears 36 is rigidly secured to the spindle 38, whereas the other spur gear 37 has a wringing fit on the spindle 38 for obtaining self alignment with the other spur gear 36. A wringing fit of the spur gear 37 as well as the play in the needle bearing 39 will make the two planet wheels 36,37 share the load evenly regardless of occurring torsional deflection of the planet wheel carrier 32.

Since the needle bearing 39 is located between the spur gears 36,37 instead of inside them, as in prior art, the spur gears 36,37 can be designed with relatively massive hub portions offering a good support for the gear teeth. Accordingly, the described planet wheel arrangement makes it possible to combine the demands for a reduction gearing having small size planet wheels and still being able to transfer relatively heavy torque loads. In other words, a reduction gearing is created that is particularly suitable for use in power nut runners, because a tool having the features of the described reduction gearing gets the favourable features of being slim in design for good accessibility and at the same time being able to deliver a high torque output during a long service life.